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NOTES ON PERUVIAN CINCHONAS—I

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THE numerous collections of species of the genus *Cinchona* made throughout the Andes during the recent war by botanists of the Foreign Economic Administration (formerly the Office of Economic Warfare) have made it possible to reexamine critically the nomenclature and taxonomy of this admittedly difficult group. During the past century, dozens of species were described in the genus, but Standley (in Field Mus. Bot. 6 (1936) 24–33) claims that many of these "pertain to forms of scarcely or not at all more significance botanically than horticultural varieties of common garden vegetables." Therefore, in the most recent treatment of the genus for Peru, Standley (*ibid.*) reduced the number of Peruvian species to a mere handful, admitting, at the same time, that additional material might make it possible to amplify his treatment.

As cinchona botanist in Peru during the period 1943–1945, the writer had the unusual opportunity of collecting and seeing in their native haunts practically all the important forms of *Cinchona* occurring in that country. As a result of this fieldwork and subsequent herbarium

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study, it is his opinion that the number of species listed by Standley for Peru, and probably elsewhere, may be increased, for among the innumerable forms, varieties, and hybrids represented in the enormous literature of the genus, there are certain well-defined concepts which appear to be more or less stable and are easily recognizable especially in the field. Even among such a notoriously variable assemblage as is contained in the complex of *Cinchona pubescens* Vahl *sensu lat.*, there are entities which appear to be very stable. As an example, one might select the tree known as *C. succirubra* Pavon ex Klotzsch which was originally collected by Richard Spruce in Ecuador. This tree wherever grown, in the Far East, in Guatemala, and elsewhere, although often under ecological conditions quite different from its homeland, remains apparently true to type, not only in its general morphological characteristics, but also in such physiological features as the patterns of alkaloidal yield.

This is understandable, for the Andean terrain, like any lofty highly-dissected mountain mass, offers an extraordinary range of very localized and disjunct habitats which have permitted active speciation to occur. Certainly if adjacent Andean *hoyas*, isolated as they often are from their neighbors, can be marked by considerable local endemism among some groups of plants, why then cannot they be so considered as to their cinchonas as well?

The writer feels that certain entities at present considered as synonyms in the genus *Cinchona* were reduced to synonymy often without sufficient study and clearly must be resurrected if any semblance of order is to come out of this chaotic group. Rusby (in Bull. Torrey Bot. Club 58 (1931) 523–530) already has protested Standley's recent treatment of the genus for Bolivia (in Field Mus. Bot. 4 (1931) 266–273), and the present writer agrees

with him in part, at least regarding the status of certain species such as *Cinchona Calisaya* Weddell which he has met with in his travels in southern Peru. Indeed, the writer cannot but feel that a great deal of careful taxonomic work was accomplished by cinchona botanists of the past centuries and especially by such men as Ruiz & Pavon and Weddell who had become well acquainted with the species in the field.

In the pages that follow, the writer initiates a critical discussion of some poorly known Peruvian cinchonas in the light of his observations in the field. The species treated in this paper are easily recognizable because of the rather dense covering of hairs found on the leaves and young growth. Our knowledge of these species, up to now, has been based for the most part on the most meagre and fragmentary of herbarium material; in fact, certain of them are known only from types collected more than a century ago. Inasmuch as the existing descriptions of these plants are either incomplete or based only on the original collection, the writer includes modified descriptions based on a study of recent collections.

Besides his own collection (WHH), the first set of which is deposited in the herbarium of the United States National Arboretum (USNA), the writer has examined specimens of cinchonas in the following institutions, to whose curators he is indebted for kindnesses received during the study: Chicago Museum (F), Gray Herbarium (G), University of Massachusetts (M), New York Botanical Garden (NY), Museo Historia Natural "Javier Prado" of Lima (L), the United States National Herbarium (US), and the herbarium of the Estación Agrícola de Tingo María in Perú (TM).

Cinchona carabayensis *Weddell*

The identity of this cinchona has remained uncertain,

since it was incompletely described by Weddell (in Ann. Sci. Nat. III. 10 (1848) 9) from fruiting material collected by him in the Province of Carabaya (Dept. of Puno). While collecting in the same area during 1943, I discovered *Cinchona carabayensis*, but unfortunately my specimens of this species were among a number lost in transit in Peru. I still have very sketchy field notes and these may be of some value in relocating the species.

In the "Flora of Peru" Standley states that *C. carabayensis* was described "from thickets on the summits of the mountains between the valleys of the Province of Carabaya, especially near San Juan del Oro." Presumably these data came from the type label, for Weddell, in his original descriptions, merely gives the locality as "Peruvia." San Juan del Oro, now long abandoned and consequently not found on modern maps, was the most famous of the Spanish placer mining centers in this auriferous zone of southern Peru and was located on the ridges separating the watersheds of the Upper Inambari (here called the Huari-Huari) and Upper Tambopata Rivers. The much overgrown site of the mine may be reached by trail in about two days from the town of Sandia. Since Weddell's time the Province of Carabaya has been divided, with the result that old San Juan del Oro, as well as most other important cinchona areas (such as the Tambopata Valley, "Valle Grande" of the Huari-Huari, etc.) in the Department of Puno, are now included in the modern Province of Sandia. On the other hand, the modern Province of Carabaya, with Macusani as the capital, occupies only that part of the old Province of Carabaya lying west of a line drawn north and south through Limbani, a line which roughly parallels the Limbani-Mina Sto. Domingo-Astillero mule trail.

It was in this same general area in early 1943 that *C.*

carabayensis was rediscovered. About a half day northeast of Sandia the present trail into the eastern forested country (called *montaña* in Peru) forks into three trails, one of which continues down the valley of the Sandia River into the old San Juan del Oro area, another cuts off over a ridge to the east to enter the Tambopata Valley, and the third runs northwesterly over a very steep ridge into the Valle Grande section of the Huari-Huari Valley via the small Cachi-Cachi placer mine. The last-named trail passes in its preliminary ascent over a very steep ridge known as Ramospata which is covered with thickets and small trees characteristic of the Andean tree-line or *ceja de la montaña*, In this thicket community *C. carabayensis*, locally called *echenique*, is common and is particularly abundant between the *tambos* (trail shelters) known as Ichubamba and Ramospata.

Specimens of this cinchona are shrubs or occasionally small trees seldom attaining a height of over three meters. In its general habit the species resembles *C. Josephiana* Weddell (also called *echenique*) which is found at lower elevations on the same slopes of the Sandia Valley. From glabrous *C. Josephiana*, *C. carabayensis* may be separated easily by the presence of tomentum which covers all young growth, twigs, inflorescence branches, lower surfaces of the leaves, etc. From my field notes is appended here a general, if still inadequate, description of this tree transcribed in the field from fresh specimens in the hand:—"leaves averaging 15 cm. long by 5.5 cm. broad, similar in shape to those of *C. Calisaya* Weddell but dull in aspect rather than lustrous and smooth; petioles similar to those of calisaya; basal portion of the midrib with a suggestion of red on the upper surface; venation more complex than that of calisaya; young leaves with scattered pubescence on upper surfaces, all leaves with tomentum beneath, the same type

of tomentum covering all parts of young growth including inflorescences; flowers distinctly pink especially in bud, fainter when open, the calyx a deeper pink changing into deep red as the young green capsule develops."

In its densely tomentose habit *C. carabayensis* differs from all other cinchonas known to me from southern Peru. The closest relative of this rare tree of the Andes of Carabaya appears to be the similarly hairy *C. Pahudiana* Howard (discussed below), a better-known tree of the Chanchamayo Region of central Peru. These two species have been considered conspecific by Standley, but the writer's impression from field observation is that they are distinct. However, the fragmentary herbarium material of *C. carabayensis* and Weddell's rather incomplete description make it impossible to compare critically these two trees. Howard noted a similarity between the two species, but pointed out correctly that one was normally a shrub, the other always a tree; he also noted differences in the leaves. Until more abundant material of *C. carabayensis* is in hand, it seems best to consider it apart, especially since the two species are rather widely disjunct. It should be pointed out that *C. Pahudiana*, not *C. carabayensis*, was the species introduced into cultivation in Java and elsewhere in the past century.

In addition to the living plants, the writer has also examined material, possibly the type (ex herb. Paris), in the herbarium of the Chicago Museum (sheet no. 971330) and collected by Weddell in the "Province of Carabaya." Besides the differences noted above, the capsules of Weddell's specimen are much coarser and more woody than those of *C. Pahudiana.* Seed differences may also exist, for the ones examined are large in comparison with those of most Peruvian cinchonas. It is hoped that botanists who may get into this interesting area of southern Peru will keep their eyes open for this neglected species.

CINCHONA GLANDULIFERA *Ruiz & Pavon*

As far as I can learn, this little-known species has not been collected until recently, since it was originally discovered and described by Ruiz and Pavon in central Peru. Standley discusses *Cinchona glandulifera* in his treatment of the genus in the Flora of Peru and states that, besides the herbarium specimen at Berlin (probably the type) which was destroyed during the war, material (an isotype?) is also to be found in the Delessert Herbarium. Fortunately a photograph (Field Museum neg. no. 102) was made of the Berlin specimen and this agrees very well with plates of this species published in the works of Ruiz and Pavon and of Howard.

Recently my good friend, Ing. Hernán Augusto (a Peruvian agronomist and Superintendent of Fundo Sinchono, and formerly associated with the U. S. Government Cinchona Mission in Peru), made available excellent specimens and data of an unidentified cinchona collected by him in the upper Monzón River valley near Tíngo María in 1944. His material proved to represent *Cinchona glandulifera*, from the type locality, and was an excellent match for the specimen of Ruiz and Pavon. The type material of Ruiz and Pavon originated in the mountains near Chicoplaya ("in *Peruviae Andium montibus nemorosis ad Chicoplaya runcationes, Carpales dictas*"). The species is also reported by them from Monzón, Panatahuas, and Cochero (also written Cocheros or Cuchero).

The type locality of Chicoplaya is not shown on most modern maps[1]; it is a hacienda in the Monzón valley

[1] Chicoplaya, type locality of *Cinchona glandulifera*, and nearby San Antonio de Playa Grande, type locality of *C. micrantha* R. & P. apparently were not visited by Ruiz and Pavon but by their collectors, including Juan Tafalla, for the localities are not indicated on the map of the itinerary of Ruiz and companions recently published (Field

about midway between Monzón and Tíngo María. It is the lowland terminus of a mule trail running down the valley from the highland community of Tantamayo.

I have also collected this species in northern Peru near the hamlet of Pomacochas in the Department of Amazonas, and specimens referable to *C. glandulifera* were collected in the same department by Antonio Raimondi, and in the Department of San Martín by Richard Spruce. The specimens from Amazonas differ somewhat from typical and topotypical material in length of petiole and in leaf shape, but otherwise are quite like the tree as it occurs in central Peru. Inasmuch as *C. glandulifera* has been found as far north in Peru as northern Amazonas, it very likely occurs in the intervening territory, particularly on the western slopes of those Andean ranges lying west of the Huallaga River. This particular inaccessible sector is actually one of the least known botanically in Peru, at least as far as the genus *Cinchona* is concerned.

Unlike most other Peruvian species, *C. glandulifera* is a shrub, in its type locality averaging three meters high (Augusto!), and in the Pomocochas area seldom attaining a height of over two meters. It is a sun-loving species always occurring among other low-growing shrubs and grasses in open communities known among the Peruvians as *pajonales*. In Pomocochas this cinchona is dominant in the community in which it occurs. Such

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Mus. Bot. 21 (1940) 9). Ruiz and Pavon apparently got no farther than Cuchero at the confluence of the Chinchao and Huallaga rivers. The localities in question are both located in the Monzón River Valley which joins the Huallaga at the site of present day Tíngo María. Both Chicoplaya and San Antonio de Playa Grande may be found on the map ("Plan del curso de los rios Huallaga y Ucayali y de la Pampa del Sacramento") made by Manuel Sobreviela—one of several maps in the atlas accompanying Herndon and Gibbon's published account of the exploration of the valley of the Amazon (Executive, No. 53, 33d Congress, House of Representatives, Washington, 1854).

sites usually are to be found on open ridges generally close to timber-line where tree types are replaced by shrubby growth and herbaceous or suffruticose perennials. Where *pajonales* merge into woodlands, types of *C. pubescens* are found, and this species is of all the cinchonas the closest associate of *C. glandulifera*. In its choice of sites and in its shrubby growth-form, hairy *C. glandulifera* is identical with *C. Josephiana* Weddell of southern Peru. However, the latter plant is easily distinguished from the former by well-marked morphological differences, the most obvious being its glabrosity.

In central Peru this diminutive species with its narrowly elongate panicles is in flower from at least February to July. Diagnostic features of *C. glandulifera*, other than its shrub form and hairiness, are the very short capsules and very small seeds.

An analysis of a composite sample of bark from several individuals of this species from Pomocochas has yielded only traces of crystallizable alkaloids, principally cinchonine. Even if the shrub were of value as a source of alkaloids, the small size of the stems would prohibit profitable commercial exploitation.

There follows an expanded description of the species based on recent collections.

Cinchona glandulifera *Ruiz & Pavon* Fl. Peruv. et Chil. 3 (1802) 1, pl. 224.

A shrub or occasionally a small tree 2–5 m. high with several trunks, these as much as 7 cm. thick; bark ashy to dark gray, the outer surface marked with inconspicuous fine transverse fissures, the youngest branchlets pilose or hirsute; stipules 12–40 mm. long, elliptical to oblong, obtuse to acute, somewhat villose; leaves subsessile, or with short petioles 2–15 mm. long, the blades ovate to lanceolate or oblong-elliptic, 6–16 cm. long, 2.5–8.5 cm.

EXPLANATION OF THE ILLUSTRATION

PLATE XXXVII. Mule trail up the Ramospata ridge out of the Sandia Valley (Dept. of Puno) Peru. In the thickets in the foreground *Cinchona carabayensis* Weddell was rediscovered.

Photograph by W. H. HODGE

PLATE XXXVII

EXPLANATION OF THE ILLUSTRATION

PLATE XXXVIII. CINCHONA GLANDULIFERA *Ruiz & Pavon* growing near Pomocochas (Dept. of Amazonas) Peru. Clump from which *Hodge 6113* was collected.

Photograph by W. H. HODGE

PLATE XXXVIII

EXPLANATION OF THE ILLUSTRATION

PLATE XXXIX. CINCHONA PAHUDIANA *Howard*. A representative specimen (*Hodge 6243*) from the region of the Chanchamayo Valley in central Peru.

Photograph by W. H. HODGE

PLATE XXXIX

EXPLANATION OF THE ILLUSTRATION

PLATE XL. CINCHONA PARABOLICA *Pavon* in thickets near Tabaconas (Dept. of Cajamarca) Peru.

Photograph by W. H. HODGE

PLATE XL

broad, the tips acute to obtuse, bases acute to obtuse or occasionally subcordate, glabrous and sometimes somewhat lustrous above, hirsute beneath, especially on the nerves, midribs usually reddish when fresh, vein-pairs 7–12; panicles generally narrowly elongate but small and compact, leafy, hairy, terminal and axillary, many-flowered, the flowers short-pedicellate, often in nodding clusters; hypanthium about 1.5 mm. long, densely yellowish-pilosulose; calyx darker, 1.5–2 mm. long with short triangular teeth, pilosulose outside, glabrous within; corolla pink, 7–12 mm. long, tomentose outside; capsule short, 7–15 mm. long, elliptical to oblong, pubescent to glabrate; seeds small, about 4 mm. long.

COLLECTIONS EXAMINED:

PERU: Huánuco: Described from the mountains of Chicoplaya, Province of Huámalies, *Ruiz & Pavon;* photograph of authentic material (presumably the type) ex herb. Berlin (Field Museum negative no. 102). Alturas de Carash (Province of Huámalies), Monzón Valley, on trail between Monzón and Tantamayo, 1735 m., *Augusto* 8, 8A (TM, WHH).—Amazonas: Summit of trail running between Pomocochas and Yambrasbamba (Province of Bóngara), 7200 feet, *Hodge 6113* (L, M, USNA, WHH). Summit of ridge separating Pomocochas from Shipasbamba (Province of Bóngara), 8500 feet, *Hodge 6109* (L, M, USNA, WHH). Valle de Huayabamba (Province of Chachapoyas), 2500 m., *Raimondi 974* (L, WHH fragment).—San Martín: In monte Campana (Province of Lamas) prope Tarapoto (now San Martín) Peruviae orientalis, *R. Spruce 4832*, Aug. 1856 (G, NY), cited doubtfully as *C. officinalis* by Standley in the Flora of Peru.—Common names: *cascarilla negrilla, cascarilla delgada, cascarilla del pajonal* (Huánuco), *cascarilla negra* (Amazonas).

CINCHONA PAHUDIANA *Howard*

Although the status of *C. carabayensis* is uncertain because of the lack of ample herbarium material, the identity of *C. Pahudiana* is sure. This rather easily identified species was originally collected by Justus Charles Hasskarl near Uchubamba which is a hamlet in the valley of the Tulumayo River (near the Chanchamayo Val-

ley) in the Province of Jauja and Department of Junín. Through the efforts of Hasskarl, living plants of *C. Pahudiana* were established by the Dutch in their plantations in Java, but, owing to the poor quality of the bark, its cultivation was eventually abandoned. Howard has given a full description and much historical information about this species. The writer has collected ample material of this tree which locally abounds in the moist timberline forests of the upper Chanchamayo Valley along the auto road between Tarma and San Ramon and not far from the type locality. The description which follows is based on these recent collections:

Cinchona Pahudiana *Howard* Ill. Nuev. Quinol. Pavon (1862) pl. 21.

A small, often slender tree 5–7 meters high, 5–20 cm. in diameter; bark thin, gray to brown[1], the branchlets pilose, the hairs usually shed below the second girdle; stipules 14–35 mm. long, 7–17 mm. wide, oblong-elliptical, obtuse (rarely acutish), pilose on the outer surfaces; leaves petiolate; the petioles 3–10 mm. long, pilose or often densely tomentose; blades oblong-elliptical to ovate or obovate, 8–28 cm. long, 4–15 cm. wide, the tip rounded to obtuse, rarely acute, the base acute, decurrent onto the petiole, glabrate or sparingly hairy usually on the veins above, generally yellowish-pilose below with longer denser hairs on the veins, with 9–12 pairs of primary lateral veins; panicles many-flowered, terminal,

[1] Dried samples of bark have a strong lateral curvature and often show narrow longitudinal ridges; there is also a strong tendency for the outer cork layers to shed. Samples analyzed by the U.S. Government Cinchona Mission Laboratory in Lima (as were all others mentioned in this paper) indicate that the species is of little value commercially, a typical analysis of trunk bark of *Hodge 6243* yielding total alkaloids 4%, anhydrous quinine 0.53%, quinine sulfate 0.65%, cinchonidine 1.02%, quinidine traces, total crystallizable alkaloids 2.25%.

the branches generally tomentose, leafy-bracteate at the base, ultimate bracts linear, approximately 2 mm. or less long; hypanthium 2 mm. long, densely tomentose; calyx 2 mm. long, sparingly pubescent to glabrate particularly at anthesis, dentate nearly to the middle, the teeth erect, triangular-acute; corolla shell pink with a deeper redder shade on outer surfaces, tube 12 mm. long, limb 4 mm. long; capsule 10–30 mm. long, lanceolate, becoming much broader in extreme dehiscence, pubescent to glabrate, prominently 10-costate.

As stated above, *C. Pahudiana* is a small tree, never shrubby like *C. carabayensis.* In general habit it more closely resembles weedy forms of *C. pubescens* Vahl *sensu lat.*, and indeed it might perhaps better be included in a subspecific category of that species. As with a number of other cinchonas, the degree of pubescence among individual trees in a stand shows considerable variation and this variability is especially to be noted in the juvenile population. Nevertheless, *C. Pahudiana* in its typical form seems to be easily identified and readily separable from *C. pubescens* both in the field and in the herbarium, because of its rather small, thick, generally tomentose leaves with bases decurrent onto the short petioles.

Collections examined:

This species is apparently of very limited local distribution in the Department of Junín of central Peru from which area all specimens have been collected. Photograph (Field Museum photograph no. 37218) of authentic (possibly type) Hasskarl material from Uchubamba in the Province of Jauja. Province of Tarma, highway between Tarma and La Merced, about 10–12 km. below Palca, 6000 ft., *Evinger 530* (L, USNA). Province of Tarma, low-statured mountain rainforests in valley of Río Palca at Utcuyacu midway on auto road between Palca and San Ramon, 2000 meters, *Hodge 6238*, *6239*, *6240*, *6241*, *6242*, *6243*, *6244*, *6248* (L, M, USNA, WHH). Thickets and open woods, Huacapistana (Province of Tarma), 1800–2400 meters, *Killip & Smith 24214* (F, NY, US) . . . has unusually long capsules; cited by Standley in Flora of Peru as *Ladenbergia Riveroana* (Wedd.) Standl. Pro-

vince of Jauja, Monobamba, 2000 meters, *Raimondi 2959, 9326, 11180* (L, WHH (fragment))[1]—Common name: *cascarilla crespilla chica* (Hasskarl!, Raimondi!).

Cinchona parabolica *Pavon ex Howard*

In 1936, Standley described *Cinchona Delessertiana*, basing his species on an unnumbered collection of Andrew Matthews (in herb. Delessert) from Chachapoyas (Department of Amazonas) in northern Peru. Commenting on his new species Standley wrote: "It is hard to understand why this Matthews collection, made long ago, has not been named, but I can find no mention of it in literature. The species is a well marked one characterized by the very dense pubescence of short, spreading hairs that cover all parts of the plant." Although the Matthews collection had remained unnamed since collected, a binomial, *C. parabolica* Pavon, had been applied to the same tree in 1862 when Howard published the "Illustrations of the Nueva Quinologia of Pavon." So Standley's name must be reduced to synonymy.

Fortunately we have not only an ample description (Pavon ex Howard) and a good illustration of the species, but also what may be considered to be the type specimen of *C. parabolica*. The latter, located in the herbarium at Madrid, was photographed by the Field Museum (photograph no. 29638) and yields the following data from the label: "*Cinchona parabolica, Cascarilla con hojas rugosas*, N. 562. L. 723. Ex Loxa." Howard states that his plate was drawn from this identical Madrid specimen. A study of the "type specimen" at Madrid and of Howard's plate and the original description indicate

[1] These specimens of Raimondi, located in the Raimondi Herbarium of the Museo de Historia Natural "Javier Prado" in Lima were tentatively identified by me in Lima as *C. glandulifera* R. & P. (see Hodge, W. H.: "Notas sobre los especímenes de cinchona del Herbario de Raimondi" in Bol. Mus. Hist. Nat. (Lima) 9 (1945) 63–64).

without doubt that *C. Delessertiana* and *C. parabolica* are identical.

An earlier name, *C. Mutisii* var. β. published by Lambert (Ill. Cinch. (1821) 9) may be referable to *C. parabolica*, but this is impossible to confirm without an examination of the type. No mention is made by Lambert of the collector of his specimen, but, like *C. parabolica*, it was probably collected by Juan Tafalla. Lambert's description is too brief for critical comparison with *C. parabolica*, but he does include in his diagnosis certain of the important features of this species:
"*foliis. . . . subtus ramulisque valde pilosis, margine undulatis subrevolutis, panicula brachiata valde pilosa. . . .*"
and also under var. β. . . . *foliis ovalibus obtusis basi rotundatis subcordatisve.*"

In 1849, Weddell took up Lambert's species, *C. Mutisii*, listing var. β. as var. *crispa*, but in 1869, Weddell, combining this variety with *C. parabolica*, transferred both entities to synonymy under another binomial of Pavon's, *C. rugosa*, a species from Cuenca, also published by Howard. A summary of the tentative synonymy of this cinchona and an expanded description based on recent collections follow:

Cinchona parabolica *Pavon ex Howard* Ill. Nueva Quinol. Pavon (1862) pl. 16.

Cinchona rugosa Pavon ex Howard *op. cit.* pl. 17.
Cinchona Mutisii Lambert var. β. Ill. Cinch. (1821) 9.
Cinchona Mutisii Lambert var. *crispa* Weddell in Ann. Sci. Nat. III, 11 (1849) 270.
Cinchona rugosa Pavon ex Howard var. *crispa* Weddell in Ann. Sci. Nat. V, 11 (1869) 359.
Cinchona Delessertiana Standley in Field Mus. Bot. 6 (1936) 26.

A small tree, 6–8 m. high, up to 10 cm. in diameter;

the older fibrous bark light to dark gray or brown, marked with short rather indistinct transverse fissures; branchlets thick, four-angled, with very dense brown pilose hairs, internodes elongate; stipules erect, soon deciduous, oblong, 12–35 mm. long with an obtuse tip, densely hispidulose on the outer surface, glabrous on the inner surface; leaves medium-sized, petiolate, subcoriaceous, bullate or rugose, especially when fresh, margins conspicuously inrolled, particularly on the younger leaves; petiole thick, 1–2 cm. long, densely hispidulose-tomentose with brownish hairs; blades oval-elliptical to oblong, 6–19 cm. long, 3–9.5 cm. wide, with apex rounded or obtuse and subapiculate, base obtuse to truncate, above often at first densely appressed-pilose, later glabrate, with veins and veinlets deeply impressed, below everywhere densely hispidulose and with short loose brown to yellowish hairs; midrib thick, usually reddish above for about a third of its length, prominent below with approximately 12–16 pairs of conspicuous lateral veins; panicles small to medium-sized (8–30 cm. across), terminal, at least the younger branches densely hairy, leafy bracteate at the base, many-flowered, the sessile flowers densely aggregate, ultimate bracts linear, 3–4 mm. long; hypanthium 2–3 mm. long, densely fulvous-tomentose; calyx 3–4 mm. long, generally reddish, densely fulvous-tomentose, toothed to the middle, the triangular teeth erect, acute; corolla maroon (the color somewhat obscured on the tube and outer surface of lobes by the dense adpressed strigose hairs, but visible in the throat of the open flower), 12 mm. long, with lobes much shorter (2 mm.) than tube; capsule up to 25 mm. long, woody with a rough-pubescent outer surface, seeds 7–8 mm. long, narrowly elliptical.

I made several collections of *C. parabolica* in northern Peru during the period 1943–1945, and some of my field

observations may be pertinent. The species was first observed growing just east of Huancabamba at Tabaconas (in the Department of Cajamarca) which is some 200 kilometers (airline) northwest of the Province of Chachapoyas, the type region for *C. Delessertiana.* Subsequently trees were also observed near Bambamarca (Cajamarca). Although cinchonas were sought in the Chachapoyas region, the species was never seen there. Mathews' specimen undoubtedly originated not in Chachapoyas itself, whose environs have long been depleted of forest, but somewhere in the outlying fringes of that province. The range of the species extends into the Loja region of southern Ecuador, the data of Pavon published by Howard giving as localities "*in via collis Laterna, in collibus Vilcabamba, Valladolid, locis altis frigidis Sabaneta, Quebrada Onda et Cruz Grande nominatis, Provincia Loja.*" Thus *C. parabolica* is known from the Departments of Cajamarca and Amazonas (and undoubtedly eastern Piura) in northern Peru and extends northwards into the Provinces of Loja and Azuay in southern Ecuador.

C. parabolica is a rather small tree, the largest example seen by me reaching a height of about twenty-five feet and a diameter of eight inches. The species is perhaps the easiest of all cinchonas to recognize, because of the very dense pubescence (noted by Standley and others) which covers all parts of the young growth of the plant. But even more characteristic in fresh material (though often lost in pressed specimens) is the strongly bullate or rugose nature of the subcoriaceous leaves whose margins often inroll or curl under conspicuously. These characters possibly account for the Spanish name *crespilla* which is not only used today among *cascarilleros* of northern Peru, but also is cited by Pavon in his descriptions of *C. parabolica* and *C. rugosa* from Ecuador. The thin, light-to-dark gray bark of this tree is quite fibrous

and the outer bark tends to show a very slight cross-fissuring. This is usually a sign among cinchonas of a valuable bark, but in this case it is almost completely lacking in alkaloids (traces only), recent wartime analyses made by the laboratory of the U.S. Government Cinchona Mission in Lima checking with the results obtained by Howard in the last century.

In northern Peru, the moist highland forests where cinchonas abound (6000–8000 feet), the so-called "cove forests," are isolated from one another by *pajonales* (grasslands or cultivated areas) and are usually limited to local *quebradas*. The ridge-margins of such forests are made up of smaller second-growth species which merge gradually and deeper in the *quebrada* with the taller dominant species of the forest climax. *C. parabolica* is a tree of the second-growth areas bordering these forests, where it is often found intermixed with a weedy variety of *C. pubescens*, called "*amarilla*," and at higher elevations sometimes with the variety of *C. officinalis* known as *loja*. Within the climax forest, often only a quarter-mile distant, large trees of *colorada*, another variety of *C. pubescens*, may grow. Thus *C. parabolica* is in close association, in northern Peru at least, with three other cinchonas. Despite this, I have not observed any signs of hybridization between *C. parabolica* and associated species of the genus.

COLLECTIONS EXAMINED:

ECUADOR: Type of *C. parabolica* "ex Loxa" (localities cited by Howard include Laterna, Vilcabamba, Valladolid, Sabaneta, Quebrada Onda, and Cruz Grande); photograph of type ex herb. Madrid (Field Museum negative no. 29638). Type of *C. rugosa* from the Province of Cuenca (Pavon ex Howard). Type of *C. Mutisii* var. β. from the Province of Loja (Pavon ex Lambert).

PERU: Amazonas: type of *C. Delessertiana* from the Province of Chachapoyas, *Mathews* (herb. Delessert, Standley!). A specimen representing *C. Delessertiana*, in the herbarium of the New York Botan-

ical Garden, bearing the label "*Mathews*, Peruvia, 1862" probably represents an isotype of Standley's species. The date appears to be incorrect, for Mathews died in 1841.—Cajamarca: Province of Jaen, border of cove forest in "Quebrada Pajonal," Tabaconas, 7000–8000 feet, *Hodge 6040*, *6054* (L, M, USNA, WHH). Frontier trail between San Ignacio and Huancabamba, approximately 8000 feet, *Hodge 6052* (L, M, USNA, WHH).—Common names: *cascarilla crespilla*, (Cajamarca, Loja); *Cascarilla crespilla con hojas rugosas* (Loja).